

CLAIMS

1. A rolled damage tolerant alloy product comprising an aluminum base alloy consisting essentially of (in weight %):

Cu	3.8 – 4.9
Mg	1.2 – 1.8
Mn	0.1 – 0.9
Fe	max. 0.12
Si	max. 0.10
Ti	max. 0.15
Zn	max. 0.20
Cr	max. 0.10
impurities	each max. 0.05
	total max. 0.15

balance aluminum,

said product having a minimum L-0.2% yield strength of 300 MPa or more, a minimum LT-0.2% yield strength of 270 MPa, a minimum T-L fracture toughness $K_{C(ao)}$ of 100 MPa. \sqrt{m} or more for a 700 mm wide CCT-panel, and having in both L/ST- and LT/ST-sections an average grain size of at least 6 according to ASTM E-112.

2. The product in accordance with Claim 1, wherein the Cu content is in a range of 3.8 to 4.7%.

3. The product in accordance with Claim 1, wherein the Cu content is in a range of 3.9 to 4.6%.

4. The product in accordance with Claim 1, wherein the Mg content is in a range of 1.2 to 1.7%.

5. The product in accordance with Claim 1, wherein the Mn content is in a range of 0.1 to 0.8%.

6. The product in accordance with Claim 1, wherein the product has minimum longitudinal (L)-0.2% yield strength of 360 MPa or more, the minimum 0.2% yield strength in the TL-direction (transverse direction) is 300 MPa.

7. The product in accordance with Claim 1, wherein the product has minimum transverse (TL)-tensile strength of 440 MPa or more and a minimum longitudinal (L)-tensile strength of 475 MPa or more.

8. The product in accordance with Claim 1, wherein the product has minimum L-T fracture toughness $K_{C(ao)}$ of 105 MPa. \sqrt{m} for 700mm wide CCT-panels.

9. The product in accordance with Claim 1, wherein the minimum T-L fracture toughness $K_{C(ao)}$ is 170 MPa. \sqrt{m} or more for 2000mm wide CCT-panels.

10. The product in accordance with Claim 1, wherein the minimum T-L fracture toughness $K_{C(ao)}$ is 175 MPa. \sqrt{m} or more for 2000mm wide CCT-panels.

11. The product in accordance with Claim 1, wherein the grain aspect ratio in both L/ST- and LT/ST-sections is 1:4 or less.

12. The product in accordance with Claim 1, wherein the grain aspect ratio in both L/ST- and LT/ST-sections is 1:3 or less.

13. The product in accordance with Claim 1, wherein the grain aspect ratio in both L/ST- and LT/ST-sections is 1:2 or less.

14. The product in accordance with Claim 1, wherein the product is a sheet product.

15. The product in accordance with Claim 1, wherein the product is a plate product.

16. The product in accordance with Claim 1, wherein the product has an average
5 grain size of 20 to 45 microns.

17. The product in accordance with any one of Claim 1, wherein the product has a
range for elongation to fracture in the L-direction from 5 to 35 %.

10 18. The product in accordance with Claim 1, wherein the product has a range for
elongation to fracture in the L-direction from 10 to 25%.

15 19. The product in accordance with Claim 1, wherein the product has a range for
elongation to fracture in the T-direction from 5 to 35 %.

20 20. The product in accordance with Claim 1, wherein the product has a range for
elongation to fracture in the T-direction from 10 to 25%.

25 21. The product in accordance with Claim 1, wherein the product has an average
grain size of according to ASTM E-112 of 6 to 8.

20 22. A composite comprising the product in accordance with Claim 1, and a cladding
on the product, the cladding comprising a higher purity aluminum alloy than said product.

25 23. A composite comprising the product in accordance with Claim 1, and a cladding
on the product, the cladding comprising a member of the group consisting of:

- (i) an alloy of the Aluminum Association AA1000 series;
- (ii) an alloy of the Aluminum Association AA6000 series; and
- (iii) an alloy of the Aluminum Association AA7000 series.

24. (Amended) A method for manufacturing a damage tolerant alloy product, comprising the steps of:

(a) casting an ingot or a slab comprising an aluminum alloy consisting of (in wt. %):

Cu	3.8 – 4.9
Mg	1.2 – 1.8
Mn	0.1 – 0.9
Fe	max. 0.12
Si	max. 0.10
Ti	max. 0.15
Zn	max. 0.20
Cr	max. 0.10
impurities	each max. 0.05
	total max. 0.15

balance aluminum;

(b) hot rolling the ingot to form an intermediate product;

(c) cold rolling the intermediate product to form a rolled product in both the length and in the width direction with a total cold deformation of more than 60%;

(d) solution heat treating the intermediate product after the cold rolling in at least one direction;

(e) cooling the solution heat treated intermediate product; and

(f) ageing the cooled intermediate product ;

said damage tolerant product having a minimum L-0.2% yield strength of 300 MPa or more, a minimum LT-0.2% yield strength of 270 MPa, a minimum T-L fracture toughness $K_{C(a0)}$ of 100 MPa. \sqrt{m} or more for a 700 mm wide CCT-panel, and having in both L/ST- and LT/ST-sections an average grain size of 20 to 45 microns, and a range for elongation to fracture in the L-direction from 5 to 35 %.

25. The method in accordance with Claim 24, wherein during step (b) the ingot is hot rolled in both the length and in the width direction.

26. The method in accordance with Claim 24, wherein during step (c) the intermediate product is first cold rolled in the one direction with a cold deformation in the range

of 20 to 55% and then further cold rolled in the other direction to a rolled product with a total cold deformation of 60% or more.

27. The method in accordance with Claim 26, wherein the process step (c) comprises the sequential steps of:

(c-i) first cold rolling the intermediate product in either the length or the width direction with a cold deformation in the range of 20 to 55%;

(c-ii) first solution heat treating the intermediate product after cold rolling;

(c-iii) tempering the solution heat treated intermediate product to a T3 or a T351-temper;

(c-iv) soft annealing the tempered intermediate product; and

(c-v) second cold rolling of the soft annealed intermediate product in at least the other direction to a final gauge thickness with a total cold deformation of more than 60%.

28. The method in accordance with Claim 27, wherein during process step (c-v) the soft annealed intermediate product is cold rolled in both the length direction and in the width direction.

29. The method in accordance with Claim 27, wherein the hot rolling of the ingot to the intermediate product occurs after homogenization, wherein the homogenization occurs at a temperature of 400 to 505°C.

30. The method in accordance with Claim 27, wherein at least one step selected from the group consisting of the first solution heat treating and the second solution heat treating occurs at a temperature of 460 to 505°C for 5 to 120 minutes.

31. The method in accordance with Claim 27, wherein the at least one member selected from the group consisting of the first solution heat treated intermediate product and the second solution heat treated intermediate product is cooled to a temperature of 175°C or lower.

32. The method in accordance with Claim 27, wherein soft annealing of the cooled intermediate product occurs at a temperature of 300 to 430°C for 0.5 to 12 hours.

33. The method in accordance with Claim 27, wherein between cold rolling passes, the intermediate product is soft annealed at a temperature of 300 to 430°C for 0.5 to 12 hours.

34. The method in accordance with Claim 24, wherein during step (b) the ingot is hot rolled in the length direction and hot rolled in the width direction, with no heating above 488°C between the hot rolling steps.

35. The method in accordance with Claim 27, wherein the total cold deformation ranges from more than 70% to at most 95%.

36. The method in accordance with Claim 24, wherein the average grain size is in the range of 26 to 45 microns.

37. An aircraft skin comprising a sheet or plate of the damage tolerant alloy product of Claim 1.

38. An aircraft skin comprising a sheet or plate of the damage tolerant alloy product made by the method of Claim 24.

39. A damage tolerant alloy rolled product comprising an aluminum base alloy consisting of (in weight %):

Cu	3.8 – 4.9
Mg	1.2 – 1.8
Mn	0.1 – 0.9
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said product having a minimum L-0.2% yield strength of 300 MPa or more, a minimum LT-0.2% yield strength of 270 MPa, a minimum T-L fracture toughness $K_{C(ao)}$ of 100 MPa \sqrt{m} or more for a 700 mm wide CCT-panel, and having in both L/ST- and LT/ST-sections an average grain size of at least 6 according to ASTM E-112.